(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 799 999 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.10.1997 Bulletin 1997/41

(51) Int. Cl.[6]: F04D 29/02, F04D 19/04

(21) Application number: 96202468.3

(22) Date of filing: 05.09.1996

(84) Designated Contracting States:
DE FR GB

(30) Priority: 05.04.1996 IT TO960265

(71) Applicant: VARIAN S.p.A.
I-10040 Leini (Torino) (IT)

(72) Inventor: Cerruti, Roberto
10139 Turin (IT)

(74) Representative: Robba, Eugenio et al
Studio "INTERPATENT"
via Caboto 35
10129 Torino (IT)

(54) A rotor for turbomolecular pump

(57) The present invention relates to a rotor (1) of a vacuum pump comprising a rotatable shaft (5) and a plurality of spaced apart parallel rotor disks (2, 3) secured to said rotatable shaft (5), such rotor being provided with a corrosion-resistant protective coating formed by a layer of polymeric material.

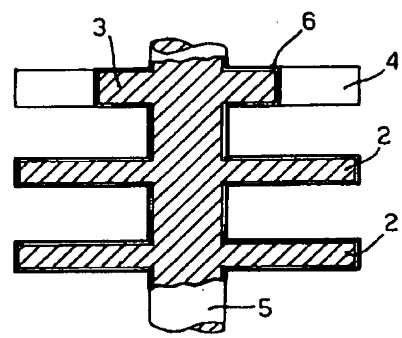

FIG. 2

EP 0 799 999 A2

Printed by Rank Xerox (UK) Business Services
2.14.14/3.4

Description

The present invention is concerned with the rotor of a vacuum pump.

More particularly the invention refers to a rotor for those vacuum pumps known as turbomolecular pumps that are to be employed in the presence of particularly corrosive gases.

As it is well known, a turbomolecular pump can schematically be regarded as comprising an outer casing in which a number of gas pumping stages are housed.

The gas pumping stages are generally obtained through an assembly of stator rings cooperating with rotor disks that are secured to a rotatable shaft driven by the pump motor.

The pumping stages comprise a space for allowing the gas flow, named pumping channel, where the surfaces of the rotor disk and the facing stator are relatively spaced away, and tight zones where the surfaces of the rotor disk and the facing stator are very near to each other.

The rotor disks can be either flat (plane) disks or disks that are provided with closely spaced apart inclined blades.

A vacuum pump of the turbomolecular type comprises both flat disks and bladed disks, and is capable to achieve low pressure levels in the order of 10^{-8} Pa.

In order to reach the above vacuum levels with the presently used pumps, the rotor must rotate at a speed near to 100,000 rpm.

It has been known to use turbomolecular pumps in the field of integrated circuits (ICs) manufacturing.

In the manufacturing cycle of integrated circuits there are used gas mixtures such as HCl, HBr, CL_2, Fl_2, NH_3, etc. that are well-known highly corrosive gases.

One of the main problem when using turbomolecular pumps in the ICs manufacturing industry is due to the accumulation of a not negligible amount of gas because of the diffusion through the pumping stages.

As a consequence, the surfaces of the internal components of the pump, particularly the rotor surface, come into direct contact with such gas mixtures and are subjected to the corrosive action thereof.

There are also known rotors for turbomolecular pumps provided with a metal or ceramic coating as a protection against the action of such corrosive gase.

The known protective metal coating is generally applied to the rotor by means of nickel-plating, zinc plating or anodizing processes.

As already mentioned the rotor of a turbomolecular pump is rotated at very high speeds, usually not lower than 25,000 rpm.

Due to the very high rotation speed of the rotor and to the extremely reduced gap between the pump rotor and the stator in the pumping stages, a mass distribution in the rotor body that is not homogeneous with respect to its axis of rotation can cause a force unbalance such as to jeopardize the working of the pump up to a failure of its components.

Thus an essential requirement in manufacturing a turbomolecular pump, particularly to be used with corrosive gases, is to achieve a substantially perfect rotational balancement of the rotor body.

The known metal or ceramic coatings used until now have the drawback of being unsuitable for application onto objects that are to remain perfectly balanced while maintaining very smooth surfaces such as the rotor of a turbomolecular pump. Namely, due to the complex geometrical shape and the small size of the areas in which the blades are attached to the rotor the thickness of the metal or ceramic coating can result as not adequate and easy to be corroded away.

In order to prevent this from happening it is often increased the amount of the protective material deposited onto the rotor body, but this countermeasure can lead to a not uniform thickness of the protection coating of the flat surfaces of the rotor disks that sometimes results in being too thick.

Consequently an additional finishing step becomes necessary in order to level the surfaces on which the deposited material has a not uniform thickness.

The object of the present invention is to overcome the above mentioned drawbacks by realizing a rotor for a vacuum pump that is corrosion resistant while at the same time has an easy and inexpensive construction.

The above objects of the present invention are accomplished by a rotor as claimed in claim 1.

Additional objects of the invention are achieved by a rotor as claimed in the dependent claims.

Further characteristics and advantages of the present invention will become evident from the description of some preferred but not exclusive embodiments thereof that are illustrated - only by way of example - in the attached drawings, in which:

Figure 1 is a perspective partial view of a rotor of a turbomolecular pump; and

Figure 2 is an enlarged cross-section view of a detail of the rotor according to the invention.

With reference to Figure 1, a rotor 1 of a turbomolecular pump comprises a plurality of flat rotor disks 2 and a plurality of rotor disks 3 provided with projecting inclined blades 4.

The rotors 2 and 3 are secured to a rotatable shaft 5 driven into rotation by a pump motor (not shown)

Referring also to the enlarged-cross section view of Fig. 2, the surface of the rotor according to the invention is covered with a polymeric protective layer or film 6 that is uniformely distributed over the whole rotor surface. The polymer is preferably a straight-chain organic compound having a molecular weight higher than 10,000 and is electrically insulating.

In the embodiment shown in Fig. 2, the thickness of the protective layer 6 is shown much larger than the real size for a better appreciation.

The coating layer 6 is preferably obtained by polym-

erisation of a reactive monomer over the rotor surface, under vacuum conditions.

In a preferred embodiment of the invention the thickness of the protective layer 6 is comprised between 12 and 20 μm, with a tolerance of about ± 2 μm, so that the thickness ranges between about 10 and 22 μm.

A preferred polymeric material for the layer 6 is a so-called poly-(p-xylylene), that is a polymer of (p-xylylene). In this case the coating process comprises a vaporisation of a dimer of (p-xylylene) under vacuum, preferably under a pressure of 100 Pa at a temperature of about 150 °C.

Then the vapour is passed through a pyrolysis zone at a temperature of about 680°C and a pressure of 50 Pa thus forming the monomer of (p-xylylene).

The monomer is then admitted into a coating chamber under a lower pressure, containing the rotor body that is kept rotating for a better distribution of the coating. The rotor is substantially at room temperature, i.e. is "cold" in respect of the monomer and this temperature difference causes a condensation with substantially simultaneous polymerisation of the reactive monomer onto the rotor surface.

A suitable dimer of (p-xylylene) is available from Ausimont under the trade name GALAXYL, or from Union Carbide under the trade name PARYLENE.

From laboratory comparative tests carried out by the applicant it has been discovered that the resistance to corrosion of a rotor treated according to the invention is much higher than that of rotors protected by conventional ceramic or metal layers.

It is deemed that the superior resistance to corrosion of the rotor according to the invention derives from both the corrosion resistant properties of the polymer coating, together with the high uniformity of the deposited layer which extends also over sharp edges or recessed areas, particularly at the junction of the rotor blades.

It is evident that the polymeric coating according to the invention can be also applied to other (stationary) components of a turbomolecular pump that are exposed to corrosion, such as the stator rings, the spacing rings located between the stators, the pump body and its inner surface.

Claims

1. A rotor (1) for a vacuum pump (1) comprising a rotatable shaft (5) and a plurality of rotor disks (2, 3), parallel and spaced apart from each other, and secured to said rotatable shaft (5), characterized in that the whole surface of said rotor is covered by a corrosion-resistant protective coating formed by a polymeric material layer having a uniform thickness comprised between 10 and 22 μm.

2. A rotor as claimed in claim 1, characterized in that said protective coating is formed by a straight-chain organic compound, electrically insulating and having a molecular weight higher than 10,000.

3. A rotor as claimed in claim 1 or 2, characterized in that said protective coating is formed through a polymerisation under vacuum of a reactive monomer onto the rotor surface.

4. A rotor as claimed in any preceding claim, characterized in that said protective coating is resistant to the corrosive action of gases used in the manufacturing of integrated circuits, particularly those of the group formed by HCl, HBr, CL_2, Fl_2, NH_3 and mixtures thereof.

5. A rotor as claimed in any preceding claim, characterized in that said polymeric material is poly-(p-xylylene).

6. A turbomolecular pump comprising a rotor (1) as claimed in claims 1 to 5.

7. A turbomolecular pump as claimed in claim 6, characterized in that at least one other stationary component of the said pump is provided with a corrosion resistant protective layer comprising a polymer.

8. A turbomolecular pump as claimed in claim 6, characterized in that said polymer is poly-(p-xylylene).

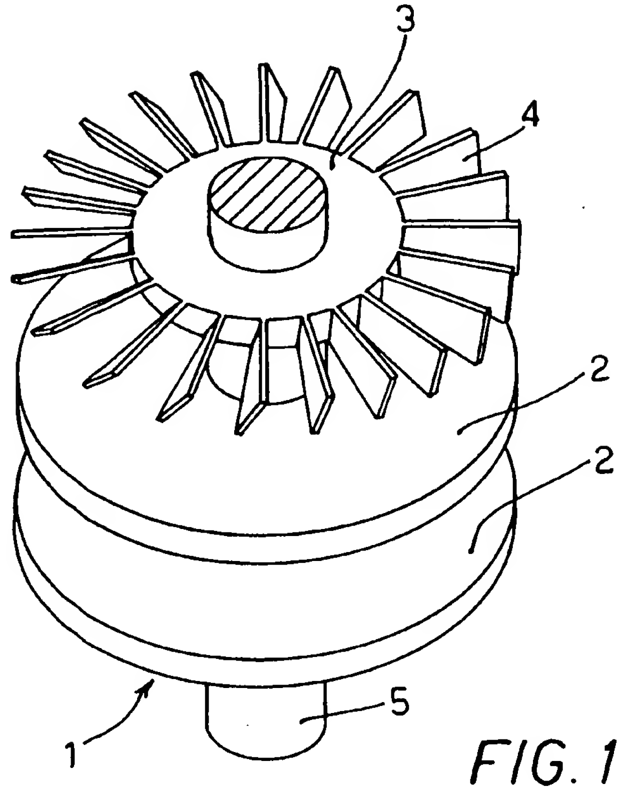

FIG. 1

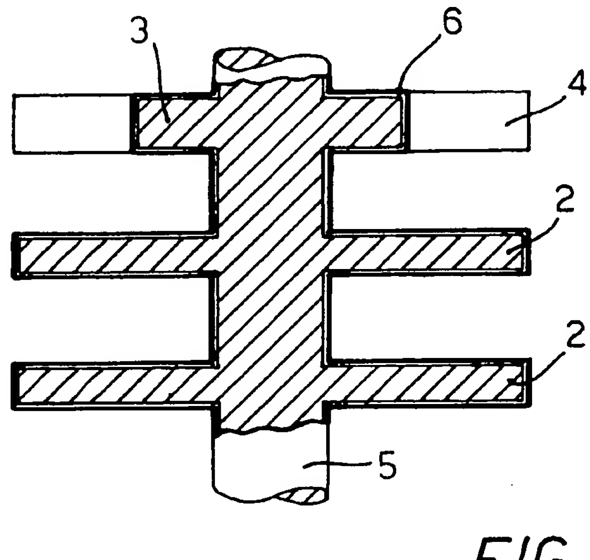

FIG. 2